ANNUAL REPORT

OF THE

NUCLEAR SCIENCE AND TECHNOLOGY FACILITY

APRIL 1, 1978 THROUGH MARCH 31, 1979

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INTRODUCTION

The utilization of the Nuclear Science and Technology Facility (NSTF) in the instructional programs of the University has continued at about the same level as the last fiscal year. Although the reactor operation was resumed in mid-July, 1978, additional repair to the cooling tower necessitated further reactor shutdown of two months. Altogether the total reactor down time during the 1978-79 fiscal year is almost six months. Under these trying circumstances, the faculty and student research programs have continued well, in spite of the resignation of Mr. Charles C. Thomas, the former Director and an active researcher in the area of radiation chemistry.

Interaction of the NSTF with other institutions has increased somewhat. With the incoming Acting Director, who has a joint appointment with the academic unit, the level of the facility utilization by the instructional programs is expected to increase rapidly. Currently, a vigorous discussion is under way with various academic units regarding the drastically-increased level of cooperation in the area of research. Several research proposals have been prepared and submitted to various agencies for possible future support.

Contrary to their originally expressed intention of paying the entire fabrication cost for the new fuel, the Department of Energy (DOE) has only paid a small fraction of it. Separately from the fuel cost, the expenditure for spent fuel element shipping is to be paid by DOE as per the original contract. The NSTF is currently operating smoothly with the new fuel elements in the core, and the necessary major repair work seems now behind us. Barring unexpected future difficulties, the facility should be able to operate the reactor for the next fifteen to twenty years without further refueling.

INSTRUCTIONAL PROGRAMS

The NSTF has an important role in both the undergraduate and graduate programs of (1) the Department of Engineering Science, Aerospace and Nuclear Engineering, (2) the Department of Biological Sciences, (3) the special majors program in Radiation Protection, and (4) miscellaneous graduate medical programs such as at Roswell Park Memorial Institute. NSTF personnel are extensively involved in teaching courr _ these programs. In addition, the facility and facility personnel are heavily involved in thesis and independent study projects.

NSTF course instruction activities range from full responsibility for courses, to limited contributions through lectures and use of the facility with the assistance of facility personnel. These activities for the 1978-79 academic year are presented in Table 1. The number of courses utilizing the facility is somewhat less than in previous years as a result of the prolonged reactor shutdown (six months) during the fiscal year. The level of activities was also affected by the departure of Mr. Charles Thomas as the Director in July, 1978, and the transient faculty situation within the Department of Engineering Science, Aerospace and Nuclear Engineering. However, it is expected that course offerings and enrollments will return to normal during the coming academic year. The estimated number of students who were involved in various aspects of academic activities at NSTF for the fiscal year is one hundred twenty (120).

Independent study projects involved widely diverse topics. During the fiscal year, projects have included gamma-ray spectroscopy of pool water, radium determination in environmental samples, and thermal neutron dosimetry with TLD system.

During the current year, the Faculty of Engineering and Applied Sciences had accreditation visitations by Engineering Council for Professional Development (ECPD) teams who examined various engineering programs, including the Nuclear Engineering program on this campus. Although the results of the accreditation visitation and the ECPD recommendation on Nuclear Engineering curriculum have not been received, the preliminary comment made by the visitation team was that increased collaboration between the NSTF and the Nuclear Engineering was possible, and indeed highly desirable.

Since the Acting Director assumed the post in late July of 1978, he has contacted various academic units to discuss closer collaboration between the NSTF and respective academic programs. Departments such as Physics, Chemistry, Nuclear Medicine, Biology, and Geology have been contacted. Also, continuing discussions are being carried out with the Faculty of Natural Sciences and Mathematics and the Faculty of Engineering and Applied Sciences in an effort to enhance their utilization of, and participation in, NSTF activities and services. In the forthcoming year, it is expected that such efforts will continue and will be extended to other academic units, such as Roswell Park Memorial Institute, the Medical School, etc.

TABLE 1

NSTF COURSE INSTRUCTION ACTIVITIES

Course No. and Title	No. of Students	Instructor	NSTF Staff Member	Fraction Taught By NSTF Staff	Facility Usage
NuE 464, Environmental Reactor Techniques	9	W. Y. Chon	L. Henry	0.8	1 recitation/week 1-3 hours/week full semester
Biology 499 Independent Study	4	A. K. Bruce	F. Thomas L. Henry	0.6 0.2	Two 3-hour lectures per week. Later two 3-hour labs per week.
Biology 600 Problems	1	A. K. Bruce	F. Thomas	0.6	1 recitation per week. One-three hours per week full semester.
NuE 507, Nuclear Reactor Safety	6	M. N. Haas		1.0	Three one-hour lectures/week. Full semester.
NuE 421, Nuclear Engineering Systems	12	W. Y. Chon		1.0	Tour
NuE 422, Applied Nuclear Design	9	W. Y. Chon		1.0	Facility Heat Exchanger System Studies
NuE 559, Thesis	6	W. Y. Chon		1.0	
EnS 501, Independent Studies	2	W. Y. Chon		1.0	
Biophysics Medical School	1	M. N. Haas		1.0	Van de Graaff Usage
Bio 461/661, Basic Radiation Science	70	A. K. Bruce	F. Thomas L. Henry	0.1	2 Labs plus special features per week

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ACADEMIC RESEARCH SUPPORT

In spite of the prolonged reactor down-time, the facility utilization in academic research projects has not declined greatly. These projects are shown in Table 2. The relative increase in thermohydraulic-type research topics reflects the new inclusion by the facility of an Electric Power Research Institute/SUNY-Buffalo research project on "Alternate ECCS Studies". The project is one of the largest nuclear safety studies on a United States university campus, the biannual research budget for 1979-80 calendar years being $245,854. Two post-doctoral research fellows and several graduate students have been supported through this project during the fiscal year.

In addition to the facility support of SUNY/Buffalo academic research projects, the facility cooperates with other universities and colleges In the past, facility use in these projects was not reimbursed fully; full costs of the projects were not recovered. This particular practice has been rectified during the fiscal year, however. While the current NSTF policy for the inhouse (SUNY/Buffalo) research support remains flexible, it has been decided to recover the full costs of service as well as the fuel-depletion for academic research support of outside (other than SUNY/Buffalo) universities. All the services, except for some transient cases, were provided on a real-cost basis. Institutions using the facility include the University of Rochester, University of Cincinnati, and University of Texas.

During the fiscal year, four research proposals were prepared in preliminary forms and submitted to various agencies, such as DOE, NRC, and SERI. The fields of research suggested in these proposals are hydrothermal stability of high-level nuclear waste, advanced canister design for vitrified and ceramic waste forms, and new solar collector performance studies. Negotiations have continued between the agencies while final proposals were readied, based on the interim feedback received from them. Professor Harry Suprinick of Engineering, and Professor Rossman Giese, Jr., of Geological Sciences, will be active participants when the proposed projects are eventually supported. Dean Duwayne Anderson of Natural Sciences and Mathematics will be a special consultant to one of these projects.

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TABLE 2

ACADEMIC RESEARCH PROJECTS

Department	Student	Faculty Member	Project Description	Degree and Status
Engineering Science	L. Henry	W. Y. Chon	Heat Transfer in PULSTAR Fuel Elements	M.S. in Progress
Engineering Science	J. Bednarek	W. Y. Chon	Four Region Model for Reflood Heat Transfer	M.S. in Progress
Engineering Science	J. Toloue	W. Y. Chon	Steam-Water Condensation Efficiency	M.S. in Progress
Engineering Science	A. Adams	W. Y. Chon	Reflood Heat Transfer Regimes	M.S. in Progress
Engineering Science	D. Ormsby	W. Y. Chon	Acoustic Augmentation in Isotope Separation	M.S. in Progress
Engineering Science	J. Bondre	W. Y. Chon	Oscillatory Reflood Heat Transfer	Ph.D. in Progress
Engineering Science	L. Green	W. Y. Chon	Bi-Coolant Solar Collector Performance	M.S. in Progress
Medicine (RPMI)	J. Robin M. Henderson	J. Ambrus	In-Vivo Analysis of Ga in Mice	Ph.D. in Progress
Geological Sciences	D. Borden	D. Hodge	Uranium, Thorium, Potassium Analysis of Rocks	
Biology	R. Byrnes	A.K. Bruce	Thermal Neutron Dosimetry with TLD system	M.S. in Progress
Biology	A. Abramowitz Mei-Yao Pei	A.K. Bruce	Radium Determination in Environmental Samples	B.S. M.S. in Progress
Biology	E. Ekeocha S. Altman	A. K. Bruce	Gamma Ray Spectroscopy of Pool Water	B.S.

TABLE 3

FACILITY USE BY OTHER INSTITUTIONS

Institution	Facility Use
University of Cincinnati	Isotope Facility Three (3) insertions 1128 hours
SUNY at Binghamton	Pneumatic Conveyor Seven (7) insertions 4.5 hours
University of Texas	Van de Graaff Three (3) hours

FACILITY OPERATIONS

The facility shutdown that began in the previous fiscal year continued into the current period. Early in 1978, all the spent fuel was shipped to Idaho and the new fuel purchased from Westinghouse Canada was received. After the remaining active fuel was stored in the hot cell, repair of the piping proceeded. Installation of the new pipe proceeded rather rapidly; however, several events caused delays that were not entirely anticipated. One delay was caused by the need to fabricate an entirely new plenum. This was brought about by the higher than anticipated activity of the old plenum. Another delay resulted from difficulty in welding a cover plate over one of the abandoned return ports to the pool. It was found that the shelf in the pool liner had suffered corrosion, and new aluminum plates had to be fabricated and installed. After filling the pool, leak tests revealed a crack in a weld, and further delay resulted.

Following successful leak tests, the reactor was re-assembled and achieved criticality on June 26th. A period of calibration and testing followed. Normal three-shift operation began on July 7th, 1978.

On December 14, a gross failure of the cooling tower gear box occurred. A replacement gear box was not stocked by the vendor, and it took seven weeks to obtain a replacement. The tower was returned to operation on February 14th. During this period some low power operation and short high power operation was possible.

The monthly operating history follows:

Month		Operating Hours	Megawatt Hours
April 1978		0	0
May		0	0
June		28.0	4.4
July		375.7	771.4
August		488.7	903.2
September		497.7	788.7
October		445.8	870.0
November		244.6	473.5
December		172.6	297.9
January 1979		32.7	19.2
February		245.3	468.7
March		490.7	943.3
	TOTALS	3021.8	5540.3

Optimum utilization of the facility with the present three-shift, five-day-a-week schedule would produce approximately 10,000 megawatt-hours. The actual yearly power generation since 1970 is listed below.

Fiscal Year	Megawatt Hours
78-79	5,540
77-78	5,809
76-77	8,303
75-76	6,845
74-75	5,357
73-74	5,774
72-73	5,526
71-72	7,879
70-71	10,229

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ACADEMIC RESEARCH

Academic departments using the facility are as follows:

Chemistry
Dr. Allendorf
1 hour Van de Graaff irradiation

Physics
Dr. Brinks
Student lab and counting room

Biology
Dr. A. K. Bruce
Conference room - 40 hours
Pneumatic conveyor - 36 insertions - 4.8 hours
Use of 10 Ci PuBe source

Medical Chemistry
Dr. Bardos
Pneumatic conveyor - 1 insertion - 30 minutes

Anthropology
B. Herbert
Pneumatic conveyor - 32 insertions - 73 minutes

Geology
Dr. Hodge
Pneumatic conveyor - 43 insertions - 43 minutes

Roswell Park Memorial Institute
Dr. Ambrus
Pneumatic conveyor - 1 insertion - 3 hours
Thermal column - 26 insertions - 44 hours
Isotope facility - 5 insertions - 27 hours

Veterans Administration Hospital
Dr. Jung
Van de Graaff irradiations - 17 hours

Many of the above activities also involved extensive use of laboratory space and equipment.

EDUCATIONAL SERVICES

This category represents services in support of course activities. Extensive use of classroom and laboratory space was also made in this connection.

3 insertions into the thermal column

3 insertions into the pneumatic conveyor

7 hours use of the subcritical reactor

12 hours reactor tie-up for student instruction.

FEDERAL AGENCIES - GRANTS

Naval Research Laboratory

Reactor tie-up time	21 hours
Reflector use	2 hours
Core space	8397 hours

(Basically NRC-sponsored PWR material testing)

GOVERNMENT AGENCY SERVICES

The increase experienced in this category over the past several years continued during the period. Additional funding of the Naval Research Laboratory (NRL) project was obtained by Dr. Martin N. Haas to further the irradiation research on reactor vessel material. The funding for the current fiscal year was $120,000, bringing the total funding so far to $310,000. In addition, a new experiment was designed as part of projected research which uses the reactor core reflector space. The new research program will study the rate effects on neutron irradiation damage. The experimental facility was built and tested at NSTF. Further experimental work is anticipated in support of this effort, which may result in a long-term test program.

ACCOUNTABILITY

Dr. M. N. Haas was assigned the responsibility of accountability officer. This position entailed the accountability of all special nuclear material in possession by the university under the federal license. A revised accountability program was subsequently instituted to incorporate the latest federal regulations on control management. The existing burn-up code was expanded into a suitable accountability document.

PUBLIC AFFAIRS AND PROFESSIONAL ACTIVITIES

The facility staff was active in a number of professional and community service organizations. Dr. M. N. Haas participated as a member of the Advisory Board to the New York State Legislative Commission on Energy Systems. This involved participation in a number of study reviews on energy matters for the State of New York.

Dr. W. Y. Chon, the Acting Director, has been involved in many public debates on nuclear safety and power, both on this campus and elsewhere. Two papers based on EPRI/SUNY-Buffalo Alternate ECCS Program were presented at the Annual American Nuclear Society meeting, and ASME Winter Annual Meeting, as follows:

(a) W. Y. Chon (with N. S. Liao, C. Addabbo and R. Duffey), "Steam Binding Reduction Through Condensation With Top Injection or Spraying", ASME Winter Annual Meeting, December 10-15, 1978, San Francisco. Published in ASME Symposium Series, "Topics in Two-Phase Heat Transfer and Flow", pp. 115-121, 1978.

(b) W. Y. Chon (with C. Addabbo and N. S. Liao), "Effects of Bottom Injection Location on Reflood Characteristics", American Nuclear Society, 1978 Annual Meeting, June 18-22, 1978, San Diego. ANS Transactions, Vol. 28, pp. 392-393, 1978.

As in the past, the facility has provided tours for visitors and a number of community groups. Although this activity was limited due to the prolonged shutdown, the facility tours have been quite active during the report period. The breakdown is given below.

AFFILIATION	NUMBER	DATE
Visitors from Mainland China	5	10/4/78
Students from Erie Community College	11	10/16/78
Students from Erie Community College	12	10/23/78
Students from Brockport	11	10/27/78
Students, Alternate Energy Systems Class	9	11/16/78
Students from Brockport	18	11/16/78
Students, SUNY/Buffalo	5	11/20/78
Physics Club of Kenmore West Senior High	18	11/30/78
Electrical Workers Apprentice Class, Syracuse	44	12/1/78
Biology Students, State University College	14	12/5/78
Boy Scouts and Parents	8	12/7/78
Niagara University Students	11	12/13/78
Students, City Honors School	21	1/5/79
SUNY/Buffalo Employee Tour	9	2/6/79
Alternate Energy Systems (Rachel Carson College)	16	2/15/79
Engineering Week	2	2/20/79
Engineering Week	8	2/21/79
Engineering Week	15	2/23/79

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AFFILIATION	NUMBER	DATE
Visitors from Korea	2	2/28/79
College of Math Sciences	4	2/28/79
Williamsville United Methodist Church	18	3/4/79
Visitors from Korea	4	3/9/79
Kenmore Presbyterian Church "Outrigger Club"	17	3/17/79
YMCA Indian Guide Program	11	3/20/79
East High School	11	3/21/79
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REGULATORY AGENCY INSPECTIONS

Routine reviews of the NSTF are made by various agencies to ensure compliance with state and federal regulations and license conditions. NSTF activities are inspected by the New York State Health Department, the New York State Department of Environmental Conservation, and various sub-groups of the U. S. Nuclear Regulatory Commission.

A routine unannounced NRC inspection was conducted on July 19-20, 1978. All aspects of facility operation were reviewed. Two infractions were found. One was a failure to calibrate the area and effluent radiation monitors on the prescribed schedule, and the other was a lack of a written procedure for the use of our isotope production facility. Both infractions were immediately corrected.

Another unannounced NRC inspection occurred on July 26, 1978. This inspection was directed toward facility security. Again two infractions were reported. The first infraction was due to a failure to test the facility security system electronics during the period that the reactor was down for repair. The second infraction involved the punch-clock records that document the fact that security officers are touring the facility as required. The records were not complete or properly labeled to ensure proper interpretation. The first problem was due to the unusual status of the facility, and administrative controls should prevent it from happening again. Changes in campus security procedures should prevent reoccurrence of the latter infraction.

FINANCIAL

The financial data for the NSTF is presented in Table 4. As might be expected from the prolonged reactor shutdown, the facility finished the year with a deficit of approximately $66,498.95 on an accounts-receivable basis.

During this report period, the lost reactor operation time was about six months, about the same as in the previous fiscal year. With the repairs to both the primary piping system and the cooling tower fan drive shaft now complete, it is expected that the forthcoming fiscal year will be a fruitful one financially. The expected increase in research volume, as well as closely-regulated service cost structure, should help ensure a successful financial operation in the future.

TABLE 4

FINANCIAL REPORT
NUCLEAR SCIENCE AND TECHNOLOGY FACILITY
STATE ACCOUNT #55155
(From 3/31/79 Budget Condition Report)

Item	Budget	Expenditure and/or Encumbrance	Free Balance
1. Salaries and Wages			
a. Teaching (0.56 FTE)	$ 18,216.00	$ 26,964.79	$ (8,748.79)
b. Non-Teaching (5.39 FTE)	81,373.00	78,974.47	2,398.53
c. Overtime, Holiday, and Inconvenience	3,739.00	178.67	3,560.33
d. Salary Transfers	(2,013.00)	(2,012.59)	(.41)
e. Temporary Services	1,320.00	98.16	1,221.84
f. Pending	2,013.00	2,012.59	.41
Total Salaries and Wages	104,648.00	106,216.09	(1,568.09)
2. OTPS	22,516.00	23,543.45	(1,027.45)
3. Expendable Account Total	127,164.00	129,759.54	(2,595.54)
4. Recharges	1,810.00	.00	1,810.00
Account Total	$128,974.00	$129,759.54	$ (785.54)

INCOME REIMBURSABLE ACCOUNT #91118
(From 3/31/79 Budget Condition Report)

Item	Appropriation	Expenditure and/or Encumbrance	Free Balance
1. Salaries and Wages			
a. Non-Teaching (14.05 FTE)	$150,184.00	$149,824.64	$ 359.36
b. Overtime, Holiday, and Inconvenience	1,700.00	1,534.78	165.22
c. Temporary Services	31,446.00	22,049.96	9,396.04
Total Salaries and Wages	183,330.00	173,409.38	9,920.62
2. OTPS	62,866.00	58,412.87	4,453.13
Total Account	$246,196.00	$231,822.25	$ 14,373.75

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TABLE 4 (continued)

INCOME

Deposits as of 3/31/79	$ 145,612.94	
Accounts Receivable 3/31/79.	19,710.36	$ 165,323.30

NET INCOME
(Based on Expenditures and Encumbrances) ($ 66,498.95)

TOTAL EXPENSE SUMMARY
STATE AND REIMBURSABLE ACCOUNTS

Item	Appropriation	Expenditure and/or Encumbrance	Free Balance
1. Salaries and Wages	$287,978.00	$279,625.47	$ 8,352.53
2. OTPS (Includes Reimbursable State Benefits)	85,382.00	81,956.32	3,425.68
3. Recharges	1,810.00	.00	1,810.00
TOTAL	$375,170.00	$361,581.79	$ 13,588.21

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ANNUAL REPORT

OF THE

RADIATION PROTECTION DEPARTMENT

STATE UNIVERSITY OF NEW YORK AT BUFFALO

Radiation Data: January 1, 1978 - December 31, 1978

Financial Data: April 1, 1978 - March 31, 1979

Report Date: June 29, 1979

Alan K. Bruce, Radiation Safety Officer

Mark A. Pierro, Radiation Protection Manager

Howe Research Laboratory, Room 15, Rotary Road, Buffalo, New York 14214
Tel (716) 831-5451

RADIATION PROTECTION DEPARTMENT ACTIVITIES

The Radiation Protection Department (RPD) is responsible for all aspects of radiation safety on the SUNY at Buffalo campuses. Individuals provided radiation protection services are those faculty staff members engaged in the use of radiation producing equipment and/or radioactive materials in the course of their research or teaching. Radiation producing equipment includes dental X-Ray units, electron microscopes and X-Ray diffraction units. The RPD also supervises radiation safety at the Nuclear Science and Technology Facility (NSTF) which houses a research reactor, an electron accelerator, and a radioisotope production facility.

Possession and use of radioactive materials at SUNY at Buffalo are authorized under separate licenses by the New York State Department of Health and the United States Nuclear Regulatory Commission. The RPD program is based on insuring compliance with regulations set forth by these licenses.

DEPARTMENT WORKLOAD AND PERSONNEL

The RPD in 1978 consisted of an averaged total of 5.99 full time staff members. During the year, two Radiation Safety Monitors and one Senior Radiation Safety Monitor were hired. Because these people were not employed for the full year, the Department was understaffed and had difficulty meeting 1978 workload demands.

Table I shows the relative time spent on various tasks associated with the SUNY at Buffalo Radiation Protection Program.

TABLE I

RADIATION PROTECTION DEPARTMENT WORKLOAD

Position	Major Duties	Workload(FTE)
Manager	1. Administration	0.6
	2. Consultation	0.1
Mark A. Pierro	3. License Revision and Renewal	0.1
	4. User Approval	0.1
	5. Training	0.1
		1
Radiation Safety Records Clerk	1. Records Maintenance	0.4
	2. Written Correspondence and Reports	0.2
M. Karen Thomas	3. Isotope Approval	0.2
	4. Telephone Correspondence	0.2
		1
Senior Radiation Safety Monitor	1. Laboratory Radiation Survey	0.4
	2. Sample Analysis	0.2
	3. Radioisotope Receipt	0.2
Ferenc A. Tibold	4. Waste Program	0.1
	5. X-Ray Equipment Survey	0.1
		1
Senior Radiation Safety Monitor	1. NSTF Radiation Protection	0.7
	2. Sample Analysis	0.05
	3. Training	0.05
Louis G. Henry, Jr.	4. Waste Program	0.1
(Hired 3/2/78)	5. Computer Programing	0.1
		1
Radiation Safety Monitor	1. Laboratory Radiation Survey	0.6
	2. Sample Analysis	0.2
Neil M. Barss	3. Radioisotope Receipt	0.1
(Hired 2/16/78)	4. Waste Program	0.05
	5. Film Badge Service	0.05
		1
Radiation Safety Monitor	1. Laboratory Radiation Survey	0.6
	2. Radioisotope Receipt	0.2
Charles A. Gentile	3. Sample Analysis	0.1
(Hired 11/6/78)	4. Waste Program	0.1
		1

TABLE I (continued)

Position	Major Duties	Workload (FTE)
Laborer	1. Processing Radioactive Waste	0.9
	2. Associated Record Keeping	0.1
Gary F. Majewski		1
Radiation Safety Officer		
Alan K. Bruce	1. Consulting, Special reports, new methods, administration	0.45
Other services not involving Department FTE's		
	NSTF Supplied Services:	
	Purchasing	0.25
	Electronic Repair/Maintenance	0.25
	Telephone - Receptionist	0.15
		0.65

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A. CAMPUS LABORATORY SURVEYS

In 1978, there were 120 authorized campus radioisotope laboratories with 93 Senior Investigators (Principal Investigators) and approximately 320 Associate Investigators (graduate students, faculty, staff, etc.). The RPD approved 16 new Senior Investigators, set up 16 new campus radioisotope labs, and decommissioned 7 labs in 1978.

Each radioisotope laboratory has a classification based on quantity and type of radioactive material used. The frequency of radiation protection surveys required depend on this classification. Table II is a breakdown of the campus laboratory survey requirements. The RPD performed 445 campus laboratory surveys during the year. The survey procedure involves: wipe testing areas of radioisotope use for removable surface contamination; direct radiation monitoring; updating associated laboratory records such as radioactive materials inventory, changes in personnel, changes in experimental protocol, etc.; insuring the proper disposal of radioactive waste materials; and conducting laboratory personnel interviews on radiation safety.

TABLE II

CAMPUS LABORATORY SURVEYS

Laboratory Classification	No. of Labs (1978)	Required Survey Frequency	Required Surveys (per year) *
A	52	2/year	72
B	31	4/year	92
C	19	1/month	108
D	18	2/month	288
TOTAL	120	-------	560

* Determined by multiplying the survey frequency by the number of laboratories. This value has been corrected for those labs that were classified as inactive which do not require surveys and for new labs starting up during the year, therefore, not requiring the full number of surveys in one year.

B. BASIC RADIATION SAFETY TRAINING COURSE

New York State Department of Health requires that all users of radioactive materials demonstrate knowledge of radiation safety. In order to meet the requirement, a short training course has been designed. The course consists of twenty hours of lecture and class demonstration, with a training manual and handout material provided by the RPD. Due to the manpower shortages, the Basic Radiation Safety Training course was not presented in 1978.

C. RADIOISOTOPE RECEIPT

A total of 670 radioisotope packages were received and processed by the RPD in 1978. All radioisotope orders must be approved by the RPD. The quantity and type of radioactive material must not exceed the limits authorized for the user. All packages are delivered first to the RPD where they are checked for removable contamination and/or excessive radiation levels. Inventory control tags are affixed to the vial(s) and the necessary paperwork is completed. Arrangements with either the User or Campus Delivery are then made to transfer the radioactive material.

D. RADIOACTIVE WASTE DISPOSAL

The RPD processes for disposal all liquid and solid radioactive waste generated by the SUNY at Buffalo campus laboratories. Waste containers are supplied by the RPD to all Users. When filled, the containers are delivered to the RPD radioactive waste processing area in the Howe Research Laboratory. The waste processing equipment includes an enclosed compactor for dry waste and a fume hood for solidifying liquid waste. The area located directly above the processing area stores up to 300-55 gallon steel drums awaiting shipment to a commercial burial site. The RPD also provides this service to authorized individuals at the Affiliated Hospitals (Roswell Park Memorial Institute, Buffalo General, Children's, Millard Fillmore, Veteran's Administration Medical Center, Meyer Clinical Center, and Erie County Labs) on a cost recovery basis. Table III shows a breakdown of the radioactive waste shipments in the fiscal year 1978.

E. X-Ray EQUIPMENT SAFETY PROGRAM

SUNY at Buffalo Radiation equipment (X-Ray diffiraction devices, Fluroscopes, electron microscopes, Therapy, radiographic and dental X-Ray machines, and an electron accelerator) must be inspected for compliance with radiation safety guidelines set up by the New York State Department of Health. Such inspections are carried out only by Certified Radiation Equipment Safety Officers (CRESO's). The RPD has 3 staff members who hold CRESO certification.

Because the University installations are inspected on a bi-annual basis, no Radiation Protection surveys were required in 1978. 692286

TABLE III

RADIOACTIVE WASTE SHIPMENTS, FISCAL YEAR 1978-1979

SHIPMENT NO.	DATE	TYPE OF WASTE			TOTAL VOLUME (CuFt)	TOTAL ACTIVITY (Curies)	MATERIALS COST ONLY	TRANSPORTATION AND BURIAL COST ONLY	TOTAL COST
		LSV **	ANIMAL	SOLID					
* 78-1	4/25/78	105	11	34	1125	0.076	$ 4,105.00	$ 3,878.00	$ 7,983.00
78-2	5/10/78	90	10	50	1125	0.086	4,640.00	3,878.00	8,518.00
78-3	9/6/78	81	11	53	1125	0.066	4,709.00	5,596.00	10,305.00
78-4	1/18/79	100	14	36	1125	0.342	4,372.00	5,641.00	10,013.00
78-5	2/14/79	97	21	32	1125	2.211	4,297.00	5,858.00	10,155.00
TOTALS		473	67	205	5625	2.780	$22,123.00	$24,851.00	$46,974.00

* This shipment represents waste collected and processed during Fiscal 1977-1978. Due to inadequate funds in Fiscal Year 1977, this shipment was delayed until 4/25/78.

** Liquid Scintillation Vials

F. EDUCATIONAL ROLE

A number of students enrolled in Bio/463/663 - Radiation Protection, participated in surveys of campus and NSTF laboratories, along with RPD personnel. In addition, a number of students in Bio/499 - Independent Study, performed projects under the direction of RPD staff members. These activities provide experience of value to those anticipating a career in these areas. Some of the projects have been substantial value to our basic knowledge of local problems. They are often projects RPD staff would work on if sufficient time were available. Further information is included in the NSTF Annual Report.

G. PERSONNEL RADIATION EXPOSURES

Personnel monitoring equipment is issued to the following individuals who are likely to receive exposures to ionizing radiation: (1) Individuals involved in the production or short lived isotopes at the NSTF (account #19339), Individuals employed at the NSTF (account 19300), (3) Campus security personnel who patrol the NSTF (account 19317), (4) Individuals involved in special projects related to radiation research (account 19334) (5) Individuals working with radioactive material on the SUNY at Buffalo campuses, and (6) Individuals working with radiation producing equipment on the SUNY at Buffalo campuses (accounts 19301 - 19357). An investigation is conducted into any exposure in excess of the Radiation Protection Guide (RPG). In addition, when accumulated exposure indicates a probability of exceeding the RPG's for the period in question, an investigation is conducted to determine the cause and to correct the situation. Table IV shows a summary of Personnel Radiation Exposures.

TABLE IV

SUMMARY OF CAMPUSES RADIATION EXPOSURES *

ACCOUNT	AVG. # OF USERS Per Month	TOTAL ACCOUNT WB EXPOSURE FOR 1978 (Rem)	ACCOUNT	AVG. # OF USERS Per Month	TOTAL ACCOUNT WB EXPOSURE FOR 1978 (Rem)
** 19339	5	4.437	19319	7.92	0.589
19300	50.75	15.071	19320	2	0.013
19317	67.90	0.458	19322	3.17	0.023
19334	29.90	1.483	19323	7	0
29413	2	0	19324	8.5	0
29424	1	0	19325	3.33	0.011
19307	5.9	0	19329	9.33	0.519
19308	6	0.192	19332	44.8	3.11
19311	1	0	19333	8.08	0.143
19321	5.01	0.052	19335	2.17	0
19326	2	0	19337	4.92	0.022
19327	1.92	0	19340	7.33	0.521
19328	8.75	0.026	19341	8.08	0.082
19330	4	0	19342	2.36	0
19331	2.58	0.104	19343	1	0
19336	3.5	0.012	19345	4	0
19338	7	0	19347	3.08	1.117
19346	10.58	0	19349	7.17	0
19354	1	0	19350	2.7	0.027
19351	1	0	19352	2	0.128
29437	3	0	19353	4	0.032
75607	1.5	0	19355	2	0
19301	3.42	0.161	19356	3	0
19302	3.5	0.031	19357	4	0
19303	13.66	0.212	19316	1	0
19304	3	0.016			
19305	1.92	0.019			
19306	4.67	0			
19310	3.92	0.035			
19312	5.83	0			
19313	11.92	0.011			
19318	5.4	0			

* Monitored Monthly

** Monitored Weekly

H. RELEASES TO THE ENVIRONS

Table V represents the routine and non-routine releases of radioactive material to the air from the NSTF's building stack and power house stack. Argon-41 is produced as a result of neutron interaction with naturally ocurring gases dissolved in the reactor pool water. Cs-138 is a particulate fission product. They are a function of reactor operation,power and time. The remaining nuclides represent losses from radioisotope production and experimental irradiation facilities (such as the Pneumatic Conveyor System and the in core Isotope Facility). All are substantially below permissible release levels.

Table VI represents the release of radioactive material to the sanitary sewer from the drains and sinks in the NSTF, containment building, and reactor pool water. They are collected in waste holding tanks and assayed prior to discharge to the sewer. The levels are substantially below maxium release values, both in total quantity and concentration.

I. PLANNED DIRECTIONS FOR COMING YEAR

To continue to meet constantly changing requirements imposed by regulatory and other external organizations within the resources available, numerous alterations of procedures are necessary. These changes fall into the general categories of waste disposal, bioassay procedures, and record-keeping.

(a) Waste Handling - Procedures to ensure that all waste containers are properly packaged and assayed prior to transport to RPD are being instituted. Each container will be assayed and certified by an RPD monitor prior to transfer to our processing area by Campus Delivery.

(b) Waste Disposal - Rapidly escalating prices for transport and burial of radioactive waste require that all alternative methods of disposal be considered.

TABLE V

SUMMARY OF 1978 AIR RELEASES

NUCLIDE	TOTAL Ci RELEASED	MAX CONCENTRATION AT POINT OF RELEASE (uCi/ml)	AVG ANNUAL CONCENTRATION (uCi/ml)	% OF PERMISSIBLE LIMIT
Routine Releases				
Powerhouse Stack Ar-41	2.09×10^{2}	6.2×10^{-5}	2.39×10^{-6}	2×10^{-1}
Building Stack Ar-41	8.04	1.1×10^{-6}	9.18×10^{-8}	4.6
Building Stack Cs-138	6.4×10^{-2}	1.4×10^{-8}	7.28×10^{-10}	7.3×10^{-2}
Non-Routine Releases				
Ar-41	2.34	5.32×10^{-5}	2.67×10^{-8}	6.7×10^{1}
Au-198	1.25×10^{-5}	5.62×10^{-8}	1.43×10^{-13}	1.4×10^{-3}
Br-82	3.92×10^{-4}	8.1×10^{-8}	4.47×10^{-12}	1.1×10^{-2}
Pd-109	1.4×10^{-4}	4.8×10^{-8}	1.6×10^{-12}	8×10^{-3}

TABLE VI

SUMMARY OF 1978 LIQUID WASTE RELEASES *

NUCLIDE	TOTAL Ci RELEASED	MAX CONCENTRATION AT POINT OF RELEASE (uCi/ml)	AVG ANNUAL CONCENTRATION (uCi/ml)	% OF MAX PERMISSIBLE CONCENTRATION
Ag-110m	9.3×10^{-3}	1.57×10^{-5}	5.37×10^{-7}	5.97×10^{-2}
Co-58	2.3×10^{-3}	3.69×10^{-6}	1.31×10^{-7}	3.28×10^{-3}
Co-60	7.2×10^{-3}	1×10^{-5}	4.19×10^{-7}	4.19×10^{-4}
Cs-134	4.6×10^{-5}	7.46×10^{-8}	2.68×10^{-9}	8.93×10^{-4}
I-131	5.4×10^{-4}	1.14×10^{-6}	3.12×10^{-8}	5.2×10^{-2}
La-140	7.9×10^{-5}	1.68×10^{-7}	4.6×10^{-9}	6.57×10^{-4}
Mn-54	1.3×10^{-3}	1.14×10^{-6}	7.26×10^{-8}	1.82×10^{-3}
Sb-124	1.5×10^{-2}	3.14×10^{-5}	8.61×10^{-7}	1.16×10^{-1}
Unidentified Beta	1.5×10^{-3}	3×10^{-6}	7.5×10^{-6}	8.33

TOTAL VOLUME RELEASED IN 1978: 51,822 gallons

TOTAL CURIES RELEASED IN 1978: 3.73×10^{-2}

* After dilution by Sanitary Sewer

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To arrive at optimum solutions, we will work with OPI and UBSFA to minimize costs within acceptable levels set by regulations pertaining to such materials. This will require the cooperation of Enviromental Health and Safety and the Maintenance Department.

(c) Record Keeping - Frequent reports are required of a wide variety of data pertaining to waste and radioisotope inventory. Current procedures should be converted to a computer-based system such that more rapid retrieval is possible.

(d) Training Courses - The need for training of new employees in basic safety methods is essential. Current staffing should allow this to be reinstituted in the near future. In addition, other methods of presenting materials, such as the use of teaching machines are being considered as a supplement.

(e) Bioassay - Recent regulations requiring thyroid bioassay for radioactive users have become effective. Measurements were initiated in the fall of 1978 and continue. With data now being collected, the methods will be refined and become a part of standard procedures.

J. NSTF REACTOR REPAIR OPERATIONS

I. Introduction

On October 7, 1977, the SUNY at Buffalo, Pulstar Nuclear Reactor was shut down due to a leak in the primary coolant outlet pipe. The leaking section of pipe, which carried primary coolant water from the reactor tank to the heat exchanger, was buried in concrete beneath the reactor containment vessel when the Facility was constructed, and hence could not be accessed for repair. Extensive modifications, including new primary piping and new reactor support structures, were therefore required. These modifications were commenced subsequent to the final spent fuel shipment on March 10, 1978. This report constitutes a review of the radiation protection procedures implemented during the repair operation as well as the resultant radiation exposures.

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II. Overview

A. Personnel Involved - The repair operations were performed and monitored by a variety of individuals. Included were members of the Operations Department, Research Department, and Radiation Protection staffs. Employees of the Joseph Davis Company and Peabody Testing Company were also involved. All workers were considered to be "occupational", and hence, exposure guidelines were based on the maximum occupational dose limits; as specified in 10CFR and Part 16 of New York State Sanitary Code.* All persons without prior nuclear experience were given an appropriate indoctrination with regards to basic radiation techniques and consequences of radiation exposure.

B. Hazards - Three basic types of radiological hazards were encountered in the operation:

1. External high radiation fields
2. Removable radioactive contamination
3. Airborne radioactive material

It was the responsibility of the RPD to ensure that appropriate measures were taken to minimize each of these hazards. Radiation exposures to all workers were maintained to below 30% of the applicable exposure guidelines.

* With the exception of one employee of the Peabody Testing Company, who was only 17 years of age.

No individual became significantly contaminated. No individual received any appreciable uptake of radioactive material.

C. Equipment

1. Instrumentation

(a) variety of portable and laboratory radiation measuring devices were utilized during the project. Included in these were:

(1) End and Side Window Geiger Survey Meters (Victoreen Thyac III, and SU-14's).

(2) Ion Chamber Survey Meters (Victoreen Radector III's, 440, Panoramic)

(3) Thin, End Window Geiger Smear Counters (with background shields).

(4) Canberra-Beckman "Low β" Proportional α/β Smear Counter.

(5) Canberra "8100" Multichannel Analyzer, in conjunction with Ge-Li and NaI detectors.

(6) A specially modified Radector III survey meter with a remote ion chamber "probe".

(7) "High Vol" Air Sampler

2. Dosimeters - Several different personnel dosimeters were used including:

(a) Civil Defense type self-reading pocket chambers; issued on an as needed basis.

(b) Victoreen-362, pocket chambers; a standard issue to all personnel.

(c) Searle Whole Body (X, β, γ, N) clip on film badges; issued to all personnel. These badges provided a legal record of whole body exposures.

(d) Searle Thermoluminescent Dosimeter (TLD) ring extremity dosimeters (X, β, γ); issued to all personnel for which an extremity dose in any calender quarter, could reasonably be anticipated to approach 900 mRem. These dosimeters also provided a legal record of exposure.

(e) Victoreen TLD Whole body (X, β, γ) clip on badges. These badges could be read at any time using an in-house TLD analyzer. Each worker active in the repairs was issued one of these badges to

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be read on a weekly basis. In addition, "special issue" badges were worn at the discretion of RPD monitors to determine exposures from a specific event such as "hot" transfers.

(f) Victoreen TLD ring extremity dosimeters (X, β, γ). These rings were also "in-house", and were issued on the same basis as the in-house whole body badges.

3. Anti-Contamination Protective Clothing

Various types of protective clothing were worn to preclude radioactive contamination of the workers. This included:

(a) Yellow plastic boots, which were fitted over the workers shoes. These were re-used when possible, but discarded if damanged.

(b) Hip waders (standard fishing type). On occasion during the process of reactor disassembly, workers entered the tank while one to two feet of contaminated water remained inside. Waders were worn on such occasions.

(c) Red plastic gloves (re-usable)

(d) Disposal latex (Tru-Touch) gloves. Generally used as a backup inside the heavier red gloves.

(e) Cotton work gloves. These gloves were used mainly in low contamination situations, and when handling rough or sharp reactor components which would likely tear the plastic gloves.

(f) Cloth coveralls. These coveralls were worn when working in the reactor tank over the workers "street clothes". The sleeves and cuffs were sealed inside the workers boots and gloves by wrapping them with masking tape. When necessary pockets, zippers, and other closures were also sealed with masking tape. These coveralls were frequently checked for contamination and were washed as necessary.

(g) Plastic coveralls. On occasion plastic coveralls were used in lieu of cloth to provide better protection from water borne contamination.

(h) Paper hats (or hoods). These were used to preclude contamination of workers heads by rubbing against contaminated surfaces.

Various combinations of these protective clothings were worn at the discretion of the RPD staff member(s) present. Said staff member(s) also decided which combination of radiation dosimeters was to be worn and where they should be worn.

4. Respiratory Protective Equipment

Air samples drawn at various times during the repair project indicated that at no time was a worker required to enter an area which would require the use of respiratory protective equipment to comply with the requirements of 10 CFR 20.103. However, to maintain worker exposures to airborne radioactive material as low as possible, workers were required to wear one of three respiratory protective devices (at the discretion of Radiation Safety Monitors).

(a) Scott Air Packs with 30 minute air tanks. These units are self contained, forced supply respirators which provide full face protection. Proper use of these respirators was explained to all Operations Department workers by a representative of the campus Enviromental Health and Safety Department. Each member of the Department was also examined by a physician and certified for respirator use.

(b) Comfo-II half face respirators with type "H" filter cartridges. Each Operations Department worker was issued one of these respirators, and was required to keep it in his possession whenever operations were being performed which could potentially produce airborne contamination. Joseph Davis and Peabody Testing Company employees were also issued this type of respirator and were required to wear them at the discretion of the attendant Radiation Safety Monitor.

(c) Paper dust masks; paper surgical masks were worn at times to preclude ingestion of dust caused by grinding and welding operations.

D. Contamination Control

Radioactive contamination was controlled quite successfully during the repair operations. Contamination levels in "clean" areas remained normal throughout the operation. Reactor Component contamination levels (removable) varied from 200 to 600,000 DPM/100 cm^2. Components which required machining or other modifications were decontaminated via standard procedures. Other components were either sealed in plastic bags, or simply stored on Kraft paper in special "contaminated equipment areas". Tools and equipment were similarly stored, or decontaminated as required.

A special area between the control room and the reactor bridge was roped off and used to suit and unsuit personnel entering or leaving the reactor tank. Workers were helped into and out of their protective clothing by a Radiation Safety Monitor or his designee. After unsuiting, a preliminary contamination check was performed on the control deck. The worker was then immediately escorted outside the containment for a geiger survey in a low background area.

E. External Radiation Exposures

The radiation exposures of all individuals were maintained well below applicable maximum exposure guidelines. A total of approximately 10 man-Rems of exposure were expended. Exposures were reviewed on a daily basis, and work assignments were rotated to more equitably distribute the exposure among the workers. An effort was made (successfully) to minimize the exposure to the younger workers as much as possible.

III. Scope of Operation

As stated earlier, the reactor repair operations were quite extensive. Considerable modification or replacement of reactor support structures and primary coolant piping were required. The reactor was first completely disassembled by the Operations Department. Repairs and testing were then performed by the Joseph Davis and Peabody Testing Companies, with assistance from the Operations Department. The reactor was then reassembled by the Operations Department. Subsequent to this reassembly, hydrostatic tests indicated that the system was not leak tight. The reactor was therefore, disassembled a second time. Replacement welds were then performed, and the reactor system was again reassemble The following is a brief outline of the work performed.

A. <u>Initial Disassembly</u> - Disassembly of the reactor commenced March 10, 1978. All active components were removed from the tank by the Operations Department. Various levels of water were maintained in the tank as the disassembly porceeded to provide shielding for the workers. Radiation surveys were performed before each step of the disassembly to allow the attendant Radiation Safety Monitor to assign protective clothing, dosimeter, respiratory protective equipment, and stay time requirements. Samples were drawn as necessary to monitor airborne radioactive material concentrations. At times a specially fabricated lead shield was placed over the fuel grid plate to provide additional shielding. Worker stay times varied from a few minutes to a few hours.

Each component was stored in a pre-arranged location. Some components were stored in the thermal column, the dry chamber, or in the beam tube storage parts. Other components were stored behind a specially fabricated concrete block wall on the neutron deck. Fuel assemblies were stored in a tank inside the Hot Cell. The reactor control blades were stored in a fuel transfer cask on the neutron deck.

Once the removable components were transferred from the tank, a wash down of the tank liner and beam tube biological shield penetrations was performed. While a comprehensive decontamination could not be performed, contamination levels were grossly reduced. This phase of the operation was completed by March 24, 1978.

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B. Tank Liner Testing - The next phase of the operation was a thorough testing and examination of the reactor tank liner (aluminum). Dye penetrant test were performed on all the liner welds by two employees of the Peabody Testing Company. Both of these workers had previous nuclear experience. One of the workers, however, was only 17 years old. Severe restrictions were therefore placed on his activities. His exposure was limited to 10 millirem.

In addition to the dye penetrant tests, ultrasonic tests were performed to survey the liner for thickness changes. These tests were performed by two of the Peabody Company employees and by members of the Operations Department. A large corrosion induced occlusion was discovered on the liner shelf, necessitating subsequent replacement of the shelf liner. The testing phase was completed in two days.

C. Welding Operations - With the liner testing complete, the actual repair operations commenced on March 28, 1979. This work was performed by the Joseph Davis Company. Nine welders and welding assistants were used. None of these workers had prior nuclear experience, and hence they were given an initial indoctrination with regards to radioactive protective procedures and methodoligies and the consequences of radiation exposure. An effort was made to insure that the Davis Company employees were constantly under the surveilance of a radiation protection, or Operations Department staff member.

Work completed by the Davis Company workers included:

1. Installation of a new plenum and core support with supporting legs.
2. Installation of new primary inlet and outlet piping.

3. Closure of abandoned primary piping liner penetrations.

4. Installation of a new shelf liner.

5. Closure of abandoned beam tube recirculation penetrations.

6. Repair of a weld crack on beam tube number four.

7. Repair of a seam on the dry chamber nose piece.

8 [illegible]ure of abandoned demineralizer return tank penetrations.

This work was completed by May 8, 1978. At this time, ..l Davis Company equipment was checked for contamination and cleaned as required before being released for use outside the Facility. All Davis Company employees were debriefed and their radiation exposures were explained to them.

D. Reassembly - The next step undertaken was reassembly of the reactor by the Operations Department. Some minor modifications were made on reassembly to make any further disassembly easier, should it become necessary. The Facility machinist was involved in the reconnection of the reactor control blades to their drive extensions. By May 18, 1978, the reactor was reassembled and transfer of the fuel assemblies back into the tank was begun.

E. Second Disassembly - Subsequent to reassembly and fuel transfer, hydrostatic tests indicated the existance of a leak or leaks somewhere in the reactor coolant boundry. Hydrophonic testing was employed in an attempt to locate the leaks. Possible leaks were found around one of the abandoned primary return penetration closures and around the abandoned primary outlet penetration closure.

A second disassembly was performed. Experience gained in the first reactor disassembly, and structural modifications made during reassembly

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allowed this disassembly to procede smoothly and quickly. The disassembly was started on June 5, 1978 and was completed on June 8, 1978.

F. Additional Welding Operations - Replacement welds were made on the leak sites by Davis Company employees. A new cover was fabricated and installed over the primary return closure. Work was hampered by malfunctioning welding equipment. This work was completed by June 12, 1978. Upon completion, the workers were briefed and their equipment was checked for contamination as before.

G. Second Reassembly - Reassembly was again accomplished by the Operations Department and the Facility machinist. This phase of the project was completed by June 20, 1978. Instrument checkouts were performed and the reactor achieved criticality on June 26, 1978.

IV. Conclusions - Some conclusions may be drawn as a result of the repair operations:

1. All reactor components are repairable or replaceable; i.e., it is demonstrated that the reactor may be disassembled and reassembled completely.
2. Deterioration of the reactor system at present is negligible.
3. The incorporation of the TLD dosimetry system is both desirable and achievable.

TABLE VII

FINANCIAL REPORT
RADIATION PROTECTION DEPARTMENT
(from 4/23/79 Budget Condition Report)

STATE ACCOUNT NO. 55170

ITEM	BUDGET	EXPENDITURES	FREE BALANCE
1. Salaries and Wages			
a. Non-Teaching (5FTE)	$65,054.00	$57,942.28	$ 7,111.72
b. Overtime	3,467.00	.00	3,467.00
c. Transfers	6,349.00	6,349.75	.75
d. Temporary Service	4,700.00	4,700.00	.00
e. Pending	6,349.00	6,349.00	(0.75)
Total Salaries and Wages	$73,221.00	$62,642.28	$10,578.72
2. OTPS	$24,842.00	$24,912.18	$ (82.78)
Expendable Account Total	$98,063.00	$87,554.46	$10,495.94

INCOME REIMBURSABLE ACCOUNT NO. 91120

ITEM	BUDGET	EXPENDITURES	FREE BALANCE
· Salaries and Wages			
a. Non-Teaching (1FTE)	$ 9,317.00	$ 8,436.46	$ 880.54
b. Temporary Service	6,000.00	118.90	5,881.10
Total Salaries and Wages	$15,317.00	$ 8,555.36	$ 6,761.64
2. OTPS	$36,568.00	$12,060.14	$ 9,267.01
Expendable Account Total	$51,885.00	$15,240.85	$16,028.65

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